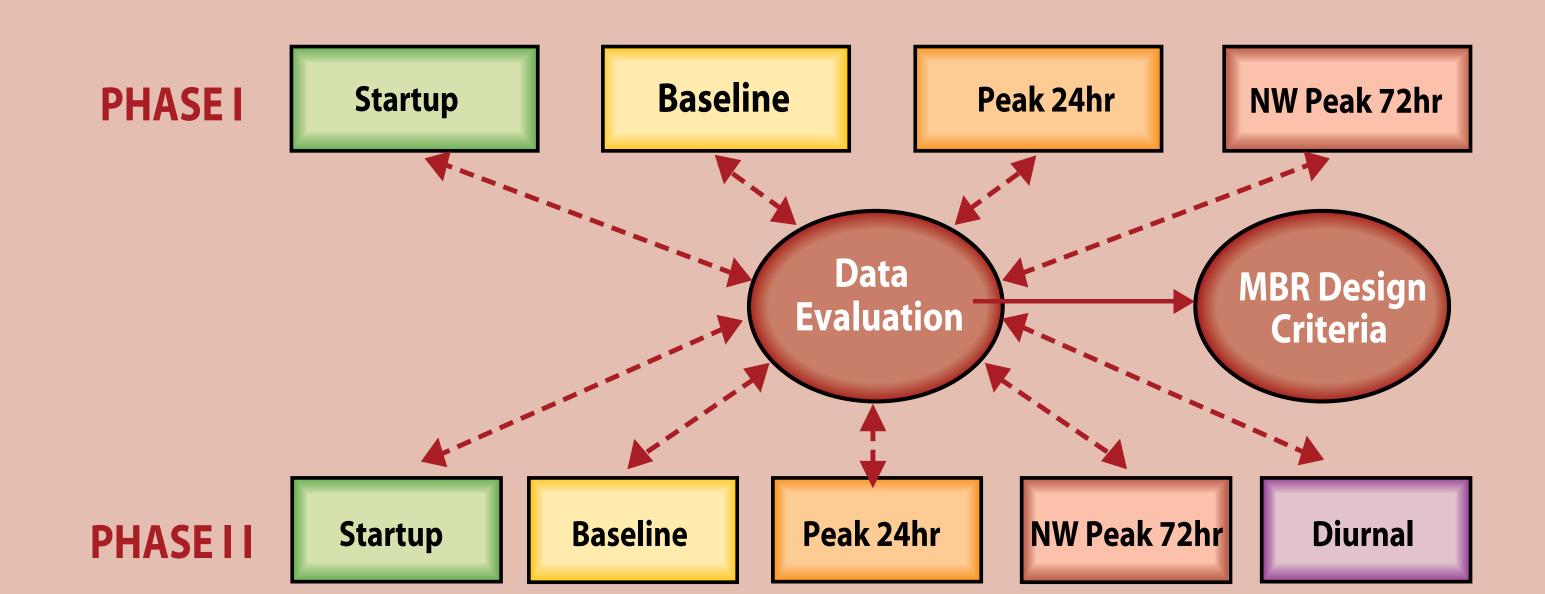
INTRODUCTION

The Challenge of Peak Flows

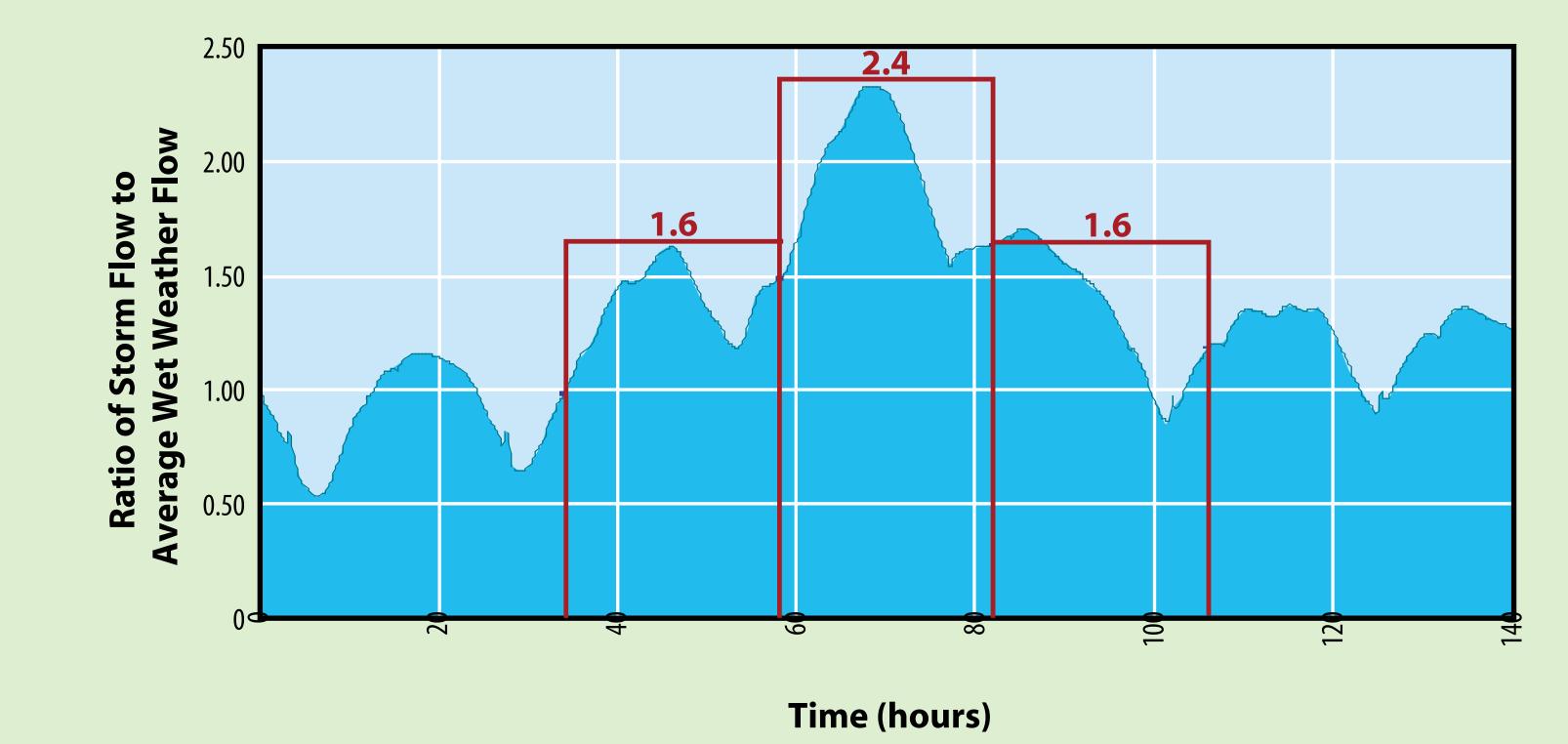
Most membrane bioreactor (MBR) systems use equalization (EQ) to handle both diurnal and seasonal fluctuations in flow. In addition, storm events can significantly increase EQ volumes and/or membrane surface area required which drive up the plant cost and footprint. King County recently completed a comprehensive pilot study (Phase I) evaluating the ability of an Enviroquip Kubota MBR process to handle a simulated storm event with and without flux enhancing polymers. In addition, a pilot study (Phase II) is being conducted to further characterize instantaneous and sustained peak fluxes while optimizing the process for energy efficiency.



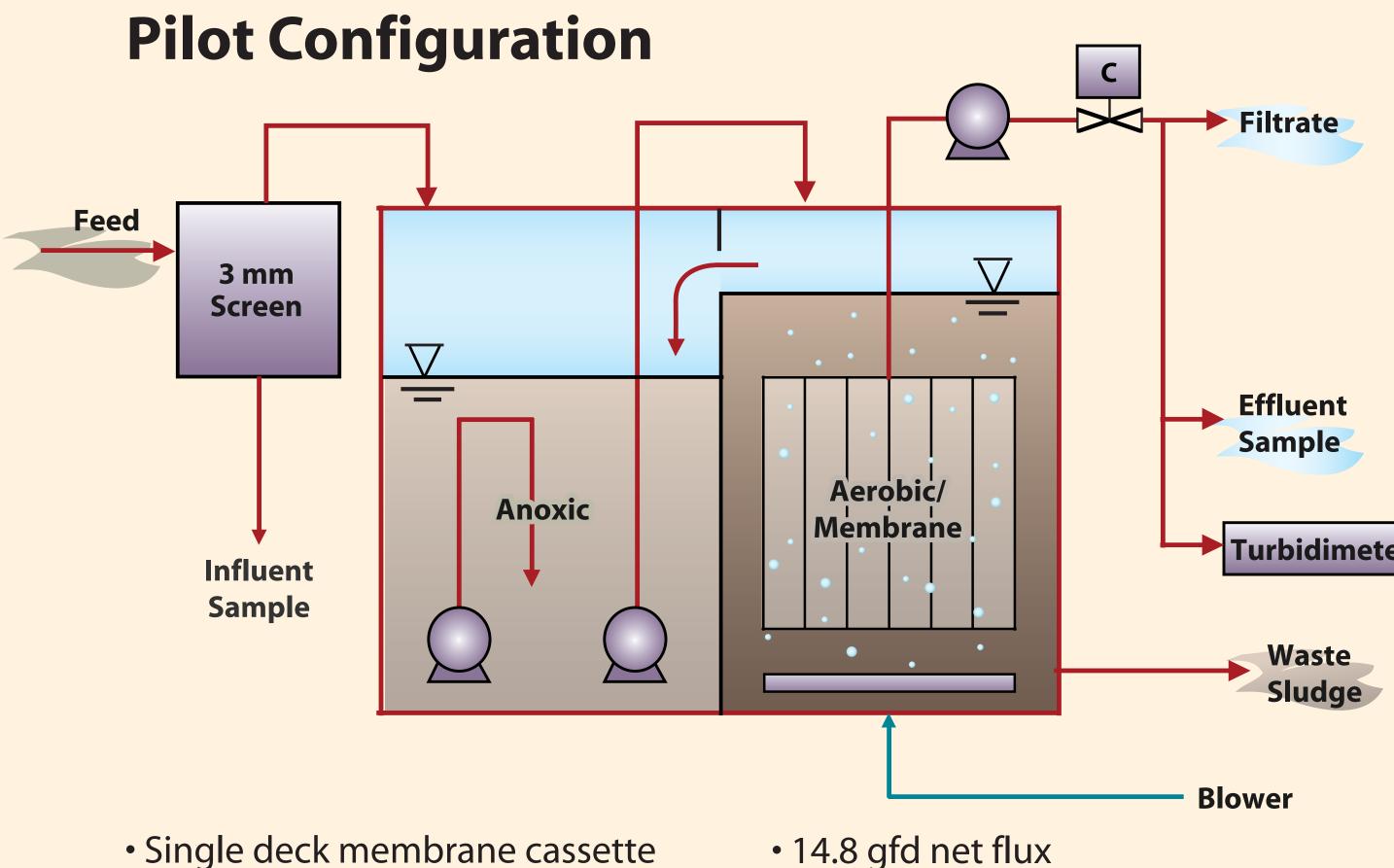
Simulating a Northwest Storm

Defining Factors:

- King County historical data
- Modeling peak hydraulic event for new treatment plant design
- Selected 72-hr event with three distinct peaking conditions (1.6 x AWWF / 2.4 x AWWF / 1.6 x AWWF)



PHASE I



- Single deck membrane cassette
- 637 sf of surface area 9,460 gpd nominal
- 0.057 scfm/sf air scour
 - Operated at King County West Point Treatment Plant in Seattle, WA

Pilot Performance

Operating Performance of the Pilot (200 day period average)

Parameter	Influent	Effluent	% Removal
TSS (mg/L)	516	1	99
BOD (mg/L)	180	< 2	99
TCOD (mg/L)	380	18	95
TOC (mg/L)	94	7	90
Ammonia (mg/L)	20	0.5	97
Turbidity (NTU)	nm	0.1	

24 Hour Peak Testing

Test	A1	A2	A3	A4 ⁽³⁾	A5	A6 ⁽⁴⁾
Feed Source ⁽¹⁾	PE	PE	PE	PE	PE	PI
Supplemental Water Source (2)	C2	C2	Potable	Potable	Potable	C2
Membrane Temperature (°C)	13	12	13	14	15	16
MLSS (mg/L)	8,355	7,680	9,360	9,300	10,270	10,530
SRT (days)	54	> 54	25	25	15	22.5
Filterability (mL/5 min)	7	4	10	10	6	6
Rate of TMP Development (psi/hr)	0.3	2.5	0.014	0.015	0.035	0.121
Duration of Test (hrs)	18	2	24	24	24	24

PE – primary effluent, PI – primary influent

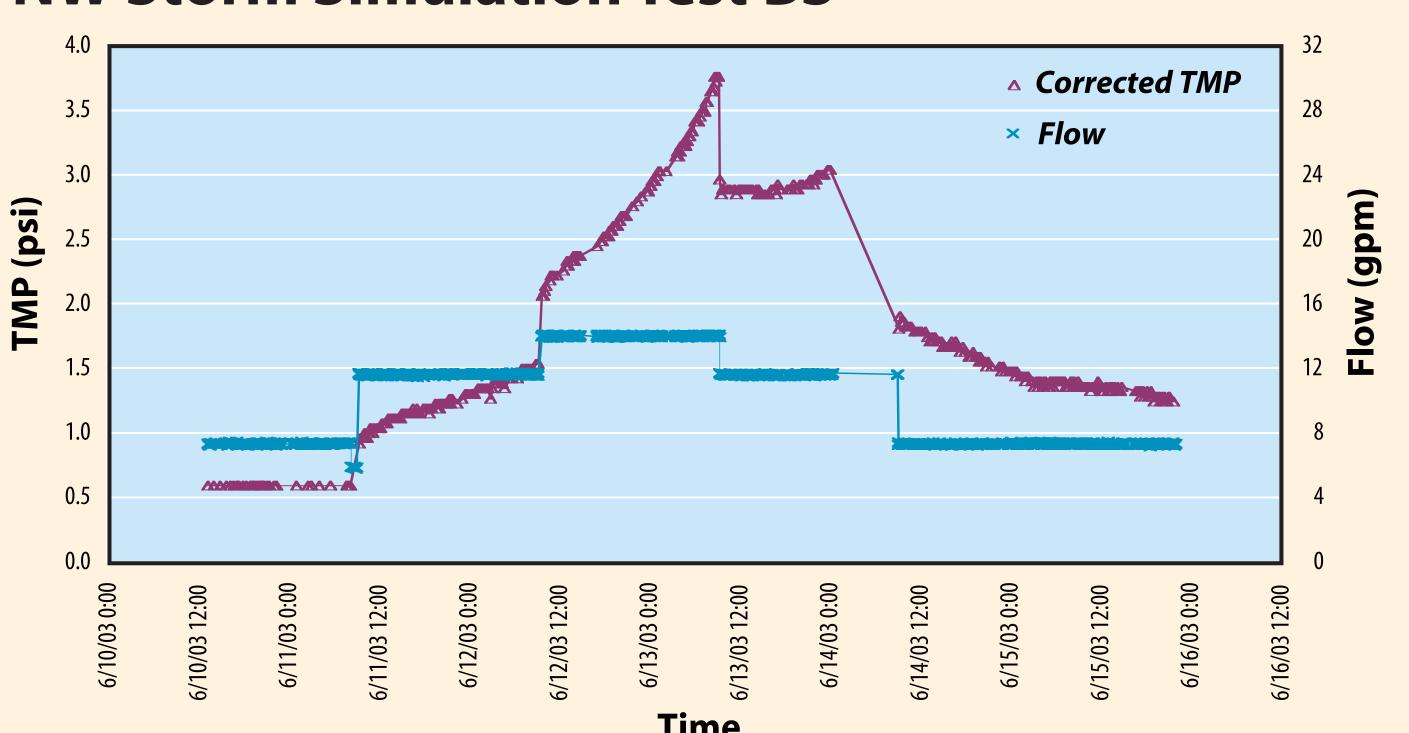
- C2 is West Point Treatment plant secondary effluent filtered through sand filter
- Air scour = 0.044 scfm/sf (other tests operated with 0.057 scfm/sf)
- 4) Test performed after 72 hr peak test with polymer addition

Northwest Storm Peak Testing (1)

Test	B1	B2	B3	B4
Feed Source (2)	PE	PE	PI	PI
Supplemental Water Source (3)	C2	C2	Potable	Potable
Polymer Addition	No	No	Yes	Yes
Membrane Cleaning During Peak Test (4)	Yes	Yes	Yes	No
Membrane Temperature (°C)	13.4	14.0	16.5	16.7
MLSS (mg/L)	8,831	7,430	9,240	12,062
SRT (days)	> 54	> 54	22.5	22.5
Filterability (mL/5 min)	7	4	7	5
Successful Completion of Test	No	No	Yes	Yes

(3) C2 is West Point Treatment plant secondary effluent filtered through sand filter.

NW Storm Simulation Test B3



Factors Affecting Phase I Peak Testing

Long sludge age characterized by dispersed floc structure

Supplemental Water Source

Treatment plant effluent water containing 8-23 mg/L sCOD versus potable water containing 1-5 mg/L sCOD

Mixed Liquor Filterability

Lower filterability values

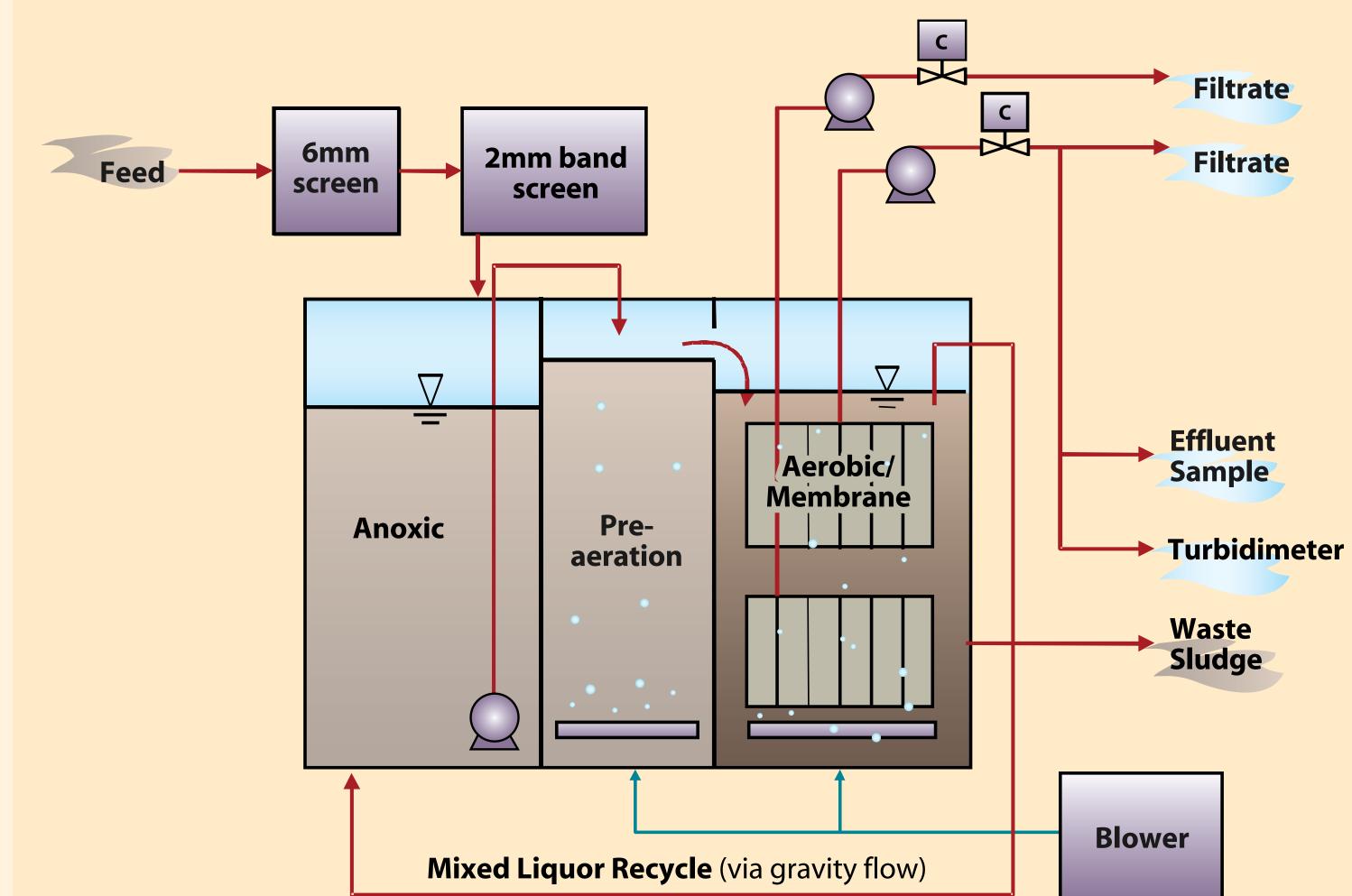
 Use of Polymer Change in floc structure

Phase I Conclusions

- Successful completion of 24-hour peak test at twice the nominal flux.
- Successful completion of 72-hour peak storm event.
- Peak test performance adversely affected by (a) long sludge age, (b) low mixed liquor filterability, and (c) use of treatment plant effluent as supplemental water
- Peak test performance improved with the addition of polymer to the mixed

PHASE II

Testing the New Membrane Design



- Double deck membrane cassette configuration
- 2,490 sf surface area
- 36,300 gpd nominal
- 14.6 gfd net flux
- 0.024 scfm/sf air scour
- Operated at King County West Point Treatment Plant in Seattle, WA

Planned Testing

Test	Peak Day	Storm Peak	Diurnal Peak ⁽³⁾	Long-Term Peak
Peak Duration (days)	1	3	0.25	30
Ratio of Peak Flux to Nominal Flux	2	2.4	2.5	1.25
Feed Source (1)	PI	PI	PI	PI
Supplemental Water Source	effluent	effluent	PI	PI
Polymer Addition	No	No	Yes	No / Yes (2)
SRT (days)	10	10	10	10

(1) PI — West Point Treatment Plant primary influent

(2) Test will be conducted with and without polymer addition (3) Test will be conducted for duration of 30 days

Peak Test Monitoring

Process Area	Parameters
Membrane	TMP, permeability, temperature
Mixed Liquor	TSS, VSS, sCOD, floc structure, filterability, CST, viscosity
Feed Source	sCOD, TCOD, TSS, VSS
Effluent	sCOD, TCOD, turbidity

Current Status of Phase II Pilot Testing

- Double-stack pilot in baseline operation under nominal flux condition.
- Peak testing scheduled to start in November 2004.
- Completion of peak testing anticipated in March 2005.





Phase II Enviroquip/Kubota double-stacked membrane Operating membrane submerged in mixed liquor

West Point Treatment Plant

NEXT STEPS:

- Confirm the ability of the membrane to handle diurnal and sustained peak events.
- MBR hydraulic and process performance.
- Confirm design operating condition of 10-12 day SRT

Contacts for More Information:

Downloadable Phase I Test Report available at: ftp://extranet.metrokc.gov/water/TAP

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